The association between living alone, loneliness and suicide mortality and effect modification by age: A case:control study

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ABSTRACT

Background: Social isolation is a potentially reversible risk factor for suicide.
Methods: A matched case control study design was used. The study population was from England and identified from an electronic primary case database with linkage to a secondary care database and Office for National Statistics mortality data. Cases were individuals who had been recorded as dying by suicide. Controls were randomly selected, matched by primary care centre and date of suicide mortality.
Results: Data were available from 14,515 cases who died from suicide and 580,159 controls. After adjustment for age and sex, the risk of suicide in individuals who had previously been reported to be either living alone or suffering loneliness was increased (Odds ratio OR 4.9; 95 % confidence intervals CI: 4.4 to 5.5). Age affected the level of this risk, with individuals aged 15 to 34 years who were lonely or lived alone having a much higher risk of suicide (OR 16.4; 95 % CI: 8.7 to 31.1).
Limitations: We can demonstrate an association between loneliness and living alone, but this may not be a causal effect. The conclusions may not be generalisable to societies outside the UK.
Conclusions: Loneliness and social isolation are associated with an approximately five-fold increase in risk of mortality from suicide, which was substantially higher in younger adults. These represent potentially reversible risk factors for suicide mortality and may also help identify individuals who are at a higher risk of suicide.

Social cohesion and integration are important elements of healthy societies, which may impact on wellbeing (Holt-Lunstad and Perissinotto, 2023). One important potentially preventable cause of death is suicide, which is more common in males compared to females (Turecki et al., 2019). We used a case-control study design of a nationally representative population-based primary care dataset to explore the association between loneliness and living alone and suicide mortality in England. The hypothesis being tested was that the exposures of loneliness or living alone may be associated with an increased risk of suicide mortality and that these associations may be modified by age.

We conducted a matched case-control study which has been described previously (Alothman et al., 2022). The study population were from the Clinical Practice Research Datalink (CPRD) which is a primary care database with a similar composition to the UK population in terms of age, sex and ethnicity (Herrett et al., 2015). These data were linked to the Office of National Statistics (ONS) mortality records and Hospital Episode Statistics (HES) database from England. The study covered the period from 2001 through 2019 and encompassed every suicide case as well as undetermined verdicts (suspicious deaths with undetermined

suicidal intent) recorded by the ONS eligible for linkage with the CPRD and HES databases. The inclusion of undetermined verdicts to studies of suicide is a recommended practice to improve the reporting of suicide given that the majority of undetermined verdicts were attributed to death caused by suicide (Linsley et al., 2001).

Controls were selected randomly from the sampling frame of the entire CPRD database linkable to the HES and ONS databases. Controls were matched to cases on suicide date (risk-set sampling) and general practice, with a maximum of 40 controls for each case. We only included patients aged 15 years or above at suicide/index date, patients with an acceptable quality of records who also had at least one year of complete records prior to the index/suicide date, and practices regarded as up to standard (for CPRD GOLD) in their completeness and continuity of records. The exposure of loneliness was coded in the CPRD data, while living alone was coded in both CPRD and HES datasets. Analysis was conducted using STATA v.16. Approval was obtained for this study from the MHRA Independent Scientific Advisory Committee – Reference Number: 20186RA.

Data were available from 14,515 cases who died from suicide and

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580,159 controls. Of those dying by suicide, 361 (2.5 %) had previously reported either living alone or loneliness (LAL) while the comparable proportion in the controls was 0.7 %, with median ages amongst these individuals of 57 and 80 years respectively (Table 1). After adjustment for age and sex, the odds ratio (OR) of suicide in individuals who had previously reported LAL was 4.9 (95 % confidence intervals CI: 4.4 to 5.5) with no interaction by sex ($p = 0.11$, likelihood ratio test). Analysis of the constituent parts of LAL demonstrated a strong association for living alone (OR 4.9, 95 % CI: 4.4 to 5.5) but no significant association with loneliness (OR 2.22, 95 % CI 0.53 to 9.25). There was a marked effect modification by age (LRT, $p < 0.0001$), with individuals aged 15 to 34 years having a much higher association between LAL and suicide mortality (OR 16.4, 95 % CI: 8.7 to 31.1) than other age groups.

Our analysis of primary care data that is broadly representative of England's population demonstrates an association between loneliness and living alone and increased risk of suicide, with this being most marked in younger individuals.

This is the first population-based analysis using routinely collected health data from England of the association between loneliness or living alone with suicide mortality. Its strengths include the validation of suicide cases using death certificate data from the ONS, along with the collection of data on the exposure of loneliness and living alone as part of routine primary care consultations.

Limitations include that these data may not be generalisable to other societies and cultures as suicide rates, and by extrapolation risk factors,

vary globally (Alothman and Fogarty, 2020). The data collection was dependent on attendance at the primary care provider, and hence higher rates of consultation for other factors associated with the suicide event may bias the data collected on loneliness and living alone. The analysis cannot exclude the possibility of reverse causality such as that the type of person who is at high risk of suicide is more likely to live alone, either by personal preference or life circumstances. All data analysed were presented, but it is evident that there were only 51 (0.009 %) individuals who were classified as lonely from a total population of 594,623 individuals. It is likely that a measure of loneliness which required individuals to present to primary care and report loneliness as a symptom that was subsequently electronically recorded and available for analysis is sub-optimal to test the hypothesis that loneliness is associated with suicide mortality. The lack of significant association with loneliness may have been the result of limitations in this measure of loneliness, or lower study power, rather than a real difference from the effect of living alone.

Nonetheless, this analysis demonstrates that those living alone are a high-risk group for suicide. This is important from a public health perspective, as suicide mortality is a potentially avoidable cause of death, which is often observed in younger individuals, with a preponderance in men (Turecki et al., 2019). Loneliness and living alone may constitute risk factors for suicide which are amenable to intervention, and could be easily identified within routine primary health care consultations or records. Although our data demonstrate the larger association between loneliness and living alone with suicide mortality in younger individuals, it does not explain the processes involved. It is difficult to generalise definitively on what are likely to be complex psychological situations that may have developed over the life-course of individuals. However, we speculate that the social benefits of living as part of a community may provide psychological support during younger adulthood.

Our results suggest a stronger association between living alone, loneliness and suicide mortality than that found by a previous cohort study using data from the UK, which reported hazard ratios of 2.16 in men who lived alone and 1.43 for self-reported loneliness. There were no similar associations in women (Shaw et al., 2021). However, the two analyses are not directly comparable, as the previous study was an analysis of older individuals aged 40 to 70 years old from a population that was recruited by invitation based on geographical region of residence and had a response rate of 5 % (Shaw et al., 2021). Our dataset was population-based and covered all eligible cases of suicide in patients aged 15 years or older, hence including the age groups in which the association is greatest and avoiding the selection bias inherent in the previous study. Studies from elsewhere have similar reported associations between social isolation and increased risk of suicide (Calati et al., 2019), supporting the hypothesis that this may be a causal effect.

The potential public health consequences of a causal effect between loneliness and social isolation are considerable, as the proportion of single person households has risen considerably, both in the United Kingdom (Office of National Statistics, 2023) and globally (Klinenberg, 2016). The World Health Organization has recently expressed concern about the increasing prevalence of loneliness and the subsequent negative impacts on health, and initiated a WHO Commission on Social Connection that will aim to see this issue recognized and resourced as a global health priority (WHO, 2023). This analysis supports this concept of increasing the profile of social isolation as an avoidable risk factor for outcomes such as suicide, especially in young adults.

Table 1
Descriptive statistics and associations of social isolation with suicide mortality.

	Suicide cases $n = 14,515$		Controls $n = 580,159$	
	LAL	Not LAL	LAL	Not LAL
Descriptive data				
All	368	14,147	4293	575,866
	(2.5 %)	(97.5 %)	(0.7 %)	(99.3 %)
Lonely	2	14,513	49	580,110
Living alone	366	14,149	4250	575,909
Sex				
Male (%)	215	10,635	1461	288,308
	(2.0 %)	(98.0 %)	(0.5 %)	(99.5 %)
Female (%)	153	3512	2832	287,558
	(4.17 %)	(95.8)	(1.0 %)	(99.0 %)
Median age[a]				
All	57.2	47.2	80.1	49.5
(IQR)	(46.3–73.6)	(35.8–59.4)	(67.6–87.1)	(35.8–64.3)
Associations with suicide mortality				
	Adjusted OR[b] (95 % CI) LAL	Adjusted OR[b] (95 % CI) Alone	Adjusted OR[b] (95 % CI) Lonely	
All	4.89	4.91	2.22 (0.53–9.25)	
	(4.36–5.47)	(4.38–5.50)		
Male	4.48	4.47	4.94 (1.042–23.45)	
	(3.85–5.21)	(3.84–5.20)		
Female	5.32	5.39	(Not enough data)	
	(4.40–6.43)	(4.46–6.52)		
15 to <35 yrs	16.43	15.81	(Not enough data)	
	(8.66–31.15)	(8.29–30.16)		
35 to <55 yrs	11.98	12.20	(Not enough data)	
	(9.46–15.15)	(9.63–15.46)		
55 + yrs	3.48	3.51	(Not enough data)	
	(2.98–4.07)	(3.00–4.12)		

LAL: living alone OR lonely; IQR: interquartile range, CI: Confidence intervals interaction terms with sex (LRT): $p = 0.21$ for LAL, $p = 0.18$ for alone, $p = 0.11$ for lonely interaction terms with age (LRT): $p < 0.0001$ for LAL; $p < 0.0001$ for alone.

[a] Median age at the suicide date for cases and index date for controls.

[b] Adjusted for age and sex across main effects, adjusted for age across sex strata; and adjusted for sex across age strata.

CRediT authorship contribution statement

Danah Alothman: Writing – review & editing, Writing – original draft, Data curation. **Sarah Lewis:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Timothy Card:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Edward Tyrrell:** Writing – review & editing, Supervision, Conceptualization. **Andrew W. Fogarty:** Writing – original draft, Supervision,

Methodology, Conceptualization.

Declaration of competing interest

None.

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